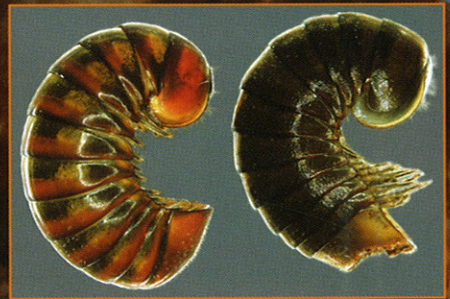




HIDDEN BIODIVERSITY: *fungi and invertebrates*

Biodiversity inventory surveys
of the south coast of Western
Australia are revealing fascinating
new species of macrofungi and
endemic invertebrates.



by Janet Newell,
Katrina Syme, Melinda Moir,
Mark Harvey and Deon Utber

Biodiversity is described as the 'variation of life at all levels of biological organisation'. The south-west of Western Australia is recognised as one of 34 international biodiversity hotspots for its high species richness, number of endemic species and its level of risk from various threats. Vascular plants and vertebrate fauna dominate our knowledge of the diversity and distribution of biodiversity. However, beneath this hides a taxonomic 'abyss' of fascinating but rarely seen life forms including ground-dwelling invertebrates such as spiders, millipedes, scorpions and velvet worms and a wondrous array of fungi including puffballs, earth stars and coral fungi.

On the south coast of WA, the regional Natural Resource Management (NRM) group, the South Coast NRM, is implementing the Biodiversity Inventory Program to target this area of poorly known and documented biodiversity. This program, implemented in partnership with the Department of Environment and Conservation's South Coast Region and the Western Australian Museum, extends from Walpole in the west to Cape Arid in the east.



The aim of the program is to conduct biological inventory surveys of poorly documented groups of biodiversity, starting with macrofungi and terrestrial invertebrates. The South Coast NRM strategy developed in 2004-05 identified these little-known areas of biodiversity as important pieces of the conservation puzzle that needed to be obtained. However, this is a massive task, as the number of species in these two groups alone is probably in the realm of tens to hundreds of thousands, of which only a relatively small proportion have been collected and formally described.

The inventory surveys conducted since early 2006 have collected data on

terrestrial invertebrates and macrofungi. Already exciting discoveries have been made including new species, both to the region and to science. This program will lead to important insights into the evolutionary and ecological history of south coast ecosystems and will identify new species including some that are rare and possibly threatened.

Macrofungi

Fungi are an integral, though often undervalued, part of healthy functioning ecosystems, playing significant roles in the decomposition of organic matter and distribution of nutrients (see 'Perth's fungi forever', *LANDSCOPE*, Autumn 2007). The number of species of fungi that occur on the south coast is unknown, though it is estimated that less than 50 per cent of macrofungi species have been discovered or named. Although the first records of fungi from the south coast were made in the late nineteenth century, fungi were largely ignored in the region until the last quarter of the twentieth century.

One reason that so little is known about fungi is their cryptic nature. The macrofungi's fine filaments, known as hyphae, spread throughout the soil and other organic matter, but identification of most species requires the examination of their fruiting bodies (e.g. mushrooms). This relies on being in the right place at the right time as, although the hyphae of a single species may cover many hectares, their fruiting bodies can pop up anywhere in that area. Most species only fruit when soil moisture content is high



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Main Orange fungi (*Dermocybe splendida*).

Photo - Ann Storrie

Inset Pill millipedes *Epiclyosoma sarahae* and *Cynotelopus notabilis*.

Photo - Melinda Moir

Above Janet Newell raking leaf litter in search of fungi at Corackerup Nature Reserve.

Left Fungus flies (*Tapeigaster* sp.) breed in fungi. This one is shown perched on the cap of *Pluteus lutescens* in the Walpole-Nornalup National Park.

Photos - Katrina Syme

Right The Australian oyster fungus (*Pleurotus australis*) is only recorded in Two Peoples Bay Nature Reserve.

Below right Seen at high magnification, the presence of metuloid cystidia—sterile cells on the face of the gills—help identify this collection as a species of *Inocybe*. Some spores are also visible.

Photos - Katrina Syme

and some only fruit every few years. Furthermore, most of these fruiting bodies are fragile, short-lived structures which are often present for only a few days before they decay.

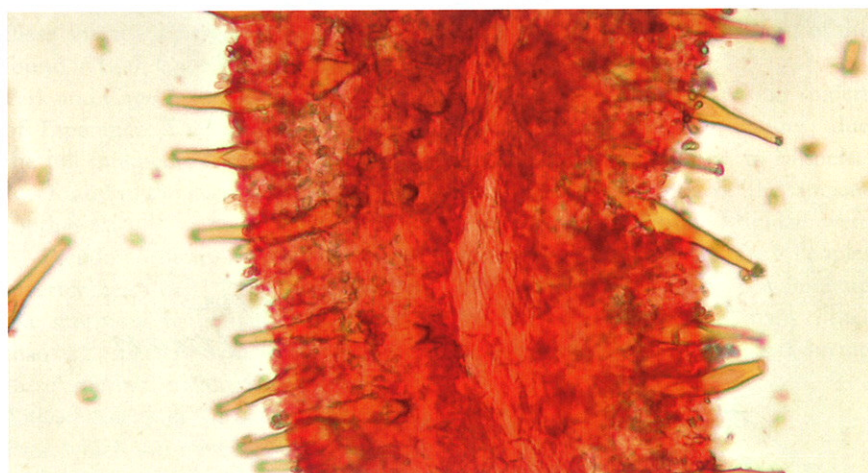
Fungi forays

While conducting surveys (forays) over the past two years, mycologist Katrina Syme recorded 622 distinguishable species from more than 400 sites as part of the Biodiversity Inventory Program. More than 70 per cent of these species have not been formally named and many of the remaining collections are still to be identified. These fungi forays have increased the number of species known for the region by more than 40 per cent.

It is difficult to identify many fungi without the use of a microscope. The fruiting bodies that could not be identified in the field during the fungi forays were photographed, collected and given field names, such as 'brownish-maroon cap'. Katrina subsequently spent each evening describing and photographing each of these specimens which were then preserved by being sectioned and dried. Many hours were spent later peering through a microscope at the spores and cell structures of these specimens to confirm or aid accurate identification. The collections were then lodged with the Western Australian Herbarium.

Fungal discoveries

Fungi come in an amazing variety of forms, colours and lifestyles. Most of the fungi recorded during the inventory survey were growing in the soil and were mycorrhizal (forming beneficial partnerships with plants) or saprophytes (decomposers of organic matter such as dead wood, leaf litter and animal dung). A few macrofungi are parasitic, such as



the Australian honey fungus (*Armillaria luteobubalina*), which is well known for causing disease and the death of many cultivated and native plant species.

The most commonly recorded species during the inventory surveys was the white dye-ball fungus (*Pisolithus albus*) which is a common and widespread species often seen along the hard-packed shoulders of roads—and sometimes even pushing through bitumen. Another commonly recorded species was the scarlet bracket fungus (*Pycnoporus coccineus*), which grows on dead wood. This easily recognisable species is a leathery, bright orange bracket that fades to a creamy pink colour.

The surveys increase the known range of many fungi species within the south coast. For example, three collections of the toothed fungus (*Auriscalpium barbatum*) from near Hopetoun and north of Esperance,

were the first collections made of this distinctive species since it was first recorded in Fitzgerald River National Park in the 1970s.

Some macrofungi species collected during the survey were found to have even broader ranges. For example, the grey-gilled porpoloma (*Porpoloma griseum* ms), which was found in dry woodland along the south coast, is otherwise only known from Mount Arapiles in Victoria, and a collection of a small waxcap (*Hygrocybe watagensis*) found at Denmark had only been collected once before in New South Wales.

The anemone stinkhorn (*Aseroe rubra*) was the first Australian fungus to be formally described by French botanist Jacques Labillardière in the late eighteenth century. It is common throughout south-eastern Australia but was recorded for the first time in WA during this survey.



Above *Nothocastoreum cretaceum*, which fruits after bushfires. The spherical fruit body splits open to reveal the inner spore mass.

Left *Gastroboletus* sp., truffle-like relatives of boletes which were collected in the Stirling Range National Park, partly uncovered by foraging animals.
Photos - Katrina Syme



Below left The type specimen of *Lycoperdon stellatum*, collected at Israelite Bay by Sarah Theresa Brooks.
Photo - Jennifer Tonkin

The most cryptic fungi are the truffle-like species which form mainly underground fruiting bodies. Many of these species are important food sources for native animals and invertebrates, including the critically endangered Gilbert's potoroo (*Potorous gilbertii*), found in Two Peoples Bay Nature Reserve. About 32 species of truffles were collected during the inventory surveys, a group of which are unnamed species of *Gastroboletus* that were uncovered by looking where foraging animals had been digging.

Terrestrial invertebrates

The invertebrate fauna of the south coast have originated from three

sources: the arid interior, species that have evolved since rainforests were replaced by the current *Eucalyptus*-proteaceous habitats, and Gondwanan relicts. Decreased rainfall in the south-west during the past 25 million years has extinguished the Gondwanan rainforests that once existed across southern Australia. Some Gondwanan species retreated and currently survive in refugial habitats such as deep gullies or mountain peaks, which have remained cooler and moister than the surroundings. These species are defined as 'short-range endemics', due to their restricted and isolated habitats. The size of the range of each of these species is limited by the small areas of

suitable habitat and the limited ability of many of the species to disperse. The restricted distribution and the specialised requirements of the species put them at risk of extinction from disturbance.

The Biodiversity Inventory Program targeted the invertebrates most likely to be short-range endemics: millipedes, snails, spiders, scorpions, harvestmen and pseudoscorpions. Surveys were carried out by Melinda Moir of the Western Australian Museum at more than 200 sites throughout the south coast. These terrestrial invertebrates were found mainly by hand collecting and leaf litter sorting with the assistance of tullgren funnels—a device used to sort invertebrates from leaf litter.

Invertebrate discoveries

Melinda was especially interested in millipedes as, through the inventory surveys, 81 species of these extreme short-range endemic species were found to occur in the south coast. Most of these species are known from only a single mountain top, and many have never before been collected. A tiny (five-millimetre) millipede of a new genus of the order Chordeumatida was discovered from unburnt regions



on Mount Manypeaks, only the second species of its order recorded in WA. The first record for the south coast of the millipede family Haplodesmidae was uncovered from leaf litter in karri (*Eucalyptus diversicolor*) forest near Walpole. Several other species, including *Atelomastix albanyensis*, were rediscovered after not being recorded for decades. This species was recorded at both Two Peoples Bay Nature Reserve and Cranbrook for the first time since 1909.

Although pill millipedes, which resemble round pills when tightly curled up after being disturbed, are common in eastern Australia, only two species are known in WA, both of which Melinda recorded during the surveys. One of

these species, *Epicyliosoma sarahae*, was found in both Cape Le Grand National Park and Cape Arid National Park, east of Esperance. The second species of the pill millipede, *Cynotelopus notabilis*, was found in the karri forests of the far south-west.

Pseudoscorpions are tiny harmless invertebrates that look superficially like scorpions without the 'tail'. More than 12 species were found during these surveys, including a species of *Sathrochthonius* in Torndirrup National Park, which was previously only known from Walpole-Nornalup National Park. All species of *Sathrochthonius* are restricted to Gondwanan regions (Australia, New Zealand and South America) and the sole Western Australian species is currently

restricted to high rainfall regions of the south coast.

Many species of trapdoor spiders have extremely small ranges due to their limited ability to disperse. Two new populations of the ancient trapdoor spider family Migidae were found in gullies within Two Peoples Bay Nature Reserve and Waychinicup National Park. Although many other trapdoor spiders were collected during

Above The pink-headed millipede of the genus *Atelomastix* is found at Two Peoples Bay Nature Reserve and Mount Manypeaks. Photo - Melinda Moir

Left Melinda Moir and Sarah Comer sampling for invertebrates by shaking the vegetation into a tray and sorting out the interesting specimens in Waychinicup National Park. Photo - Janet Newell

Below The burrow of a trapdoor spider in Stirling Range National Park. The spider uses *Allocasuarina* needles as trip lines to detect its prey. Photo - Melinda Moir





Left *Bothriembryon glauerti*, an endangered snail, from the Stirling Ranges.

Below A rock spider (Selenopidae family) found under rocks along the south coast. Note the small pseudoscorpion, *Synsphyronus callus*, to the left which is sharing the same rock.
Photos – Melinda Moir

these surveys, most were females, which could not be accurately identified as the main taxonomic features are found in males. Future research at the Western Australian Museum will be aimed at using molecular sequence data to accurately identify female and juvenile specimens.

Bugs, insects with sucking mouthparts, were not generally a target during these surveys. However, an astonishing new genus of bug was found living with ants near Ravensthorpe. Although ants are known to share nests with other taxa such as beetles, this is the first known recording in the world of a member of the bug family Flatidae co-habiting with ants.

More to uncover

These inventory surveys have made a start at improving our current knowledge of the distribution,

taxonomy and conservation status of poorly known biodiversity throughout the region. To date from these surveys, two new species and a new genus of invertebrate, plus one species of macrofungi are in the process of being described, with numerous others to follow. One of the new species of invertebrate, the millipede *Epicyllosoma sarahae*, has been nominated for State conservation listing.

These inventory surveys have raised awareness among south coast land managers and the general public of the existence of these components of biodiversity and the importance of their conservation. The surveys have also helped to identify areas of high biodiversity and special interest. For example, Cape Le Grand National Park east of Esperance contains seven species of millipede, five of which are found nowhere else.

Yet this is only a first step towards understanding these components of biodiversity. For example, more than 60 per cent of the recorded fungi species were only collected from one location, demonstrating the urgent need for more on-going surveys in understanding the distribution and diversity of such species. And within that taxonomic 'abyss' there are still other groups, such as other invertebrates, mosses, liverworts and hornworts, which are similarly poorly known and documented.

As for our well-known flora and fauna, these poorly known components of biodiversity are under threat from habitat disturbances such as land clearing, weed incursions, *Phytophthora* dieback, inappropriate fire regimes and predicted climate changes, due to the small ranges and specific habitat requirements of many of these species.

South Coast NRM will use the findings from the Biodiversity Inventory Program to guide future investment through the Australian Government's new Caring for Our Country program and other funding sources which will support further surveys and management of our hidden biodiversity, including macrofungi and short-range endemic invertebrates.



Janet Newell is a technical officer for the Department of Environment and Conservation (DEC) working on the South Coast Natural Resource Management (NRM) Biodiversity Inventory Program. She can be contacted by email (janet.newell@dec.wa.gov.au).

Katrina Syme is a mycologist and botanical artist based on the south coast, where she has been learning about, documenting and painting fungi since 1982.

Dr Melinda Moir worked for the Western Australian Museum on the Biodiversity Inventory Program short-range endemic invertebrate surveys. She is now a researcher with the University of Melbourne.

Dr Mark Harvey is a Senior Curator at the Western Australian Museum specialising in the systematics of invertebrates.

Deon Utber is DEC's Regional Biodiversity Facilitator for South Coast NRM.

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Phone (08) 9334 0296 Fax (08) 9334 0432.

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